“Boundary Work for Water Sustainability and Urban Climate Adaptation: Lessons from the Decision Center for a Desert City”

Scholars and other stakeholders increasingly recognize the need to integrate scientific knowledge from multiple disciplines and link this knowledge to decision making to support sustainable development. Efforts to enhance the contributions of science to sustainability, however, have met with mixed success. To enhance the linkages between knowledge and action, recent sustainability research has focused on the social networks of actors, institutions, and dynamics involved in producing and using scientific knowledge for environmental decision-making. This research highlights the significance of active boundary work to support collaboration between different stakeholder groups for the cooperative production of knowledge that is scientifically credible, salient to decision making, and respectful of diverse perspectives. One boundary work strategy involves the participatory development of simulation models and decision support systems. The process of building such models can help stakeholders develop a shared understanding of complex systems, feedbacks, and uncertainties and to incorporate environmental, social, and economic considerations. Furthermore, the models can be combined with innovative visualizations such as 3D graphics, digital globes, or immersive decision theaters to create and evaluate scenarios that are realistic and inclusive. Such visualizations and scenarios may be more effective in engaging decision-makers and mobilizing societal action for sustainable development. In this talk, Dr. Dave White will discuss these issues using illustrations from work conducted by Arizona State University’s Decision Center for a Desert City (DCDC) and Decision Theater (DT).

He will highlight recent research that utilizes a participatory, mixed-method approach, including survey questionnaire, scenario analysis, and simulation modeling, to construct distinct, coherent, plausible, and desirable governance scenarios of the Phoenix, Arizona USA region in 2030. Four scenarios provide stakeholders and policy makers with distinct options for future water governance regimes, while the approach integrates normative values and preferences with dynamic models to inform sustainable policy making. The first scenario, *Technical Management for Megapolitan Development*, based on the stakeholder survey, describes a future in which water experts negotiate and acquire more water so Phoenix can continue to grow. The second scenario, *Citizen Councils Pursue Comprehensive Sustainability,* was selected using the sustainability appraisal. This scenario describes a future where watershed-like councils use policy instruments to reduce water use as part of a comprehensive approach to sustainability that includes integrated policy making for water, energy, food, and urban planning. *Experts Manage Limited Water for Unlimited Growth* is the third scenario, selected using plausibility indications, and describes a future where water experts struggle to provide for a growing population without restricting water use or acquiring new water sources. Water governance reflects a classic “muddling through” approach. The final scenario, *Collaborative Governance Prioritizes Local Water Security*, selected using the water security governance analysis, is a future in which water is very central to decision making. In this scenario, committees of water managers, scientists and citizens collaborate to secure water and reduce consumption to ensure the long-term viability of the metropolitan region.

Each of the four scenarios was input into WaterSim 5.0 to determine their systemic impacts under different climate scenarios. The suite of models resulted in 270 separate model runs for the 75 year

simulation period for each of the 33 water utilities and the four constructed synthetic scenarios plus one base scenario.

Our approach then allows for normative scenarios to interface with a dynamic simulation model, which during stakeholder engagement activities can provide feedback to participants on the impacts of their priorities, particularly on the availability of surface and groundwater for future generations and the distribution of burdens and benefits of water and water governance. Stakeholders can then modify or dictate preconditions for their priorities and, if necessary, select new scenarios. This type of iteration and feedback with differing levels of stakeholder involvement is critical in transdisciplinary research generally and for participatory scenarios that inform transitions in particular.

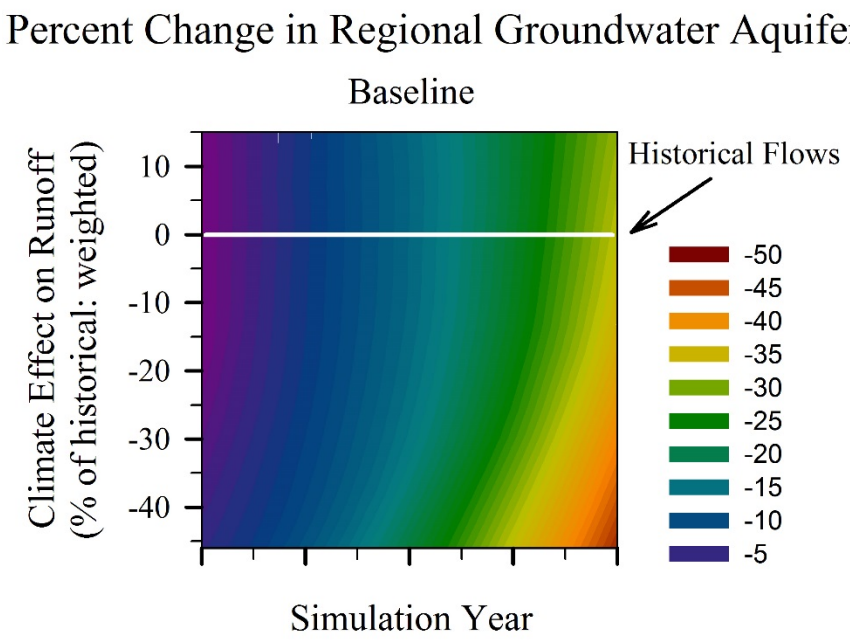
The scenarios in this study can be considered boundary objects, which allow for knowledge exchange between different actors related to their opinions, values, and preferences regarding all or parts of the water system. In this capacity, the scenarios present different water governance regimes with different power arrangements in a way that is comprehensible to broad audiences. For the Phoenix region, the scenarios can also facilitate conversations with other regions about water governance. Bounding the governance regime to the Phoenix region is a necessity of the scenario construction process that does not necessarily reflect the governance or hydrological reality. In the future, Phoenix will be negotiating for water with other state and regional actors, particularly those with rights to the Colorado River. By selecting a scenario to guide transition activities, Phoenix will have a boundary object with which to communicate its priorities to its partners on the Colorado River. Such efforts could contribute to further coordination of sustainable water governance across the Southwest.

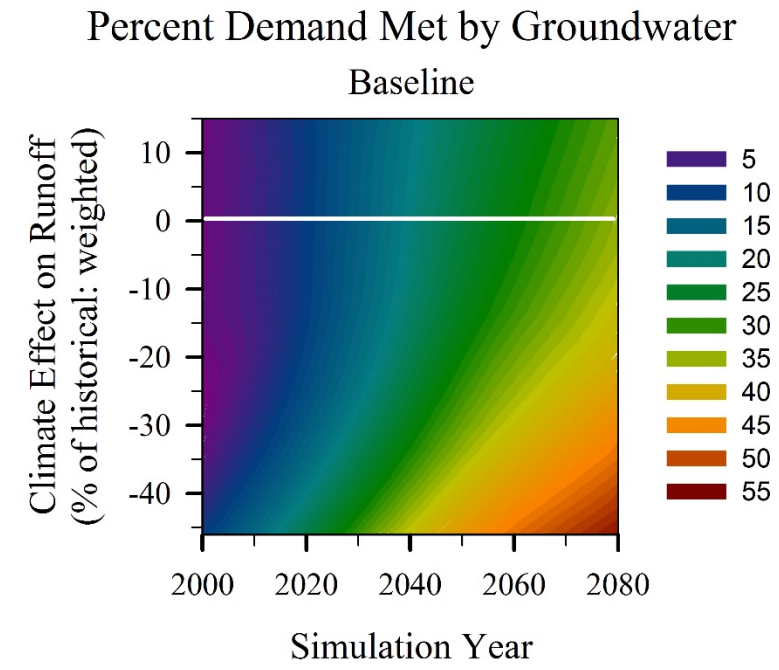
Speaker Bio

Dr. Dave D. White is Associate Professor in the Arizona State University (ASU) School of Community Resources and Development, and Principal Investigator and Director of the Decision Center for a Desert City (DCDC). Funded by the National Science Foundation since 2004, DCDC serves as a boundary organization linking science and policy for water sustainability and urban climate adaptation. Dr. White's research and engagement is focused on developing, implementing, and studying processes, outcomes, and institutional forms to link knowledge to action for sustainability. This work has contributed to the development and refinement of new tools and techniques for collaborative environmental decision making such as the DCDC WaterSim model. Dr. White's research has been published in dozens of scientific journal articles and has been featured in popular media including The New York Times. Dr. White also holds appointments at ASU as Senior Sustainability Scientist with the Julie Ann Wrigley Global Institute of Sustainability, and as affiliate faculty with the Consortium for Science, Policy, and Outcomes and the School of Public Affairs. Dr. White is a recipient of the President's Medal for Social Embeddedness from Arizona State University for his contribution to an environmental education program for minority youth. He was awarded the Celebrating Natural Resources Award from the University of Idaho in 2014. He received his Ph.D. from Virginia Tech, M.S. from the University of Idaho, and B.S. from George Mason University.

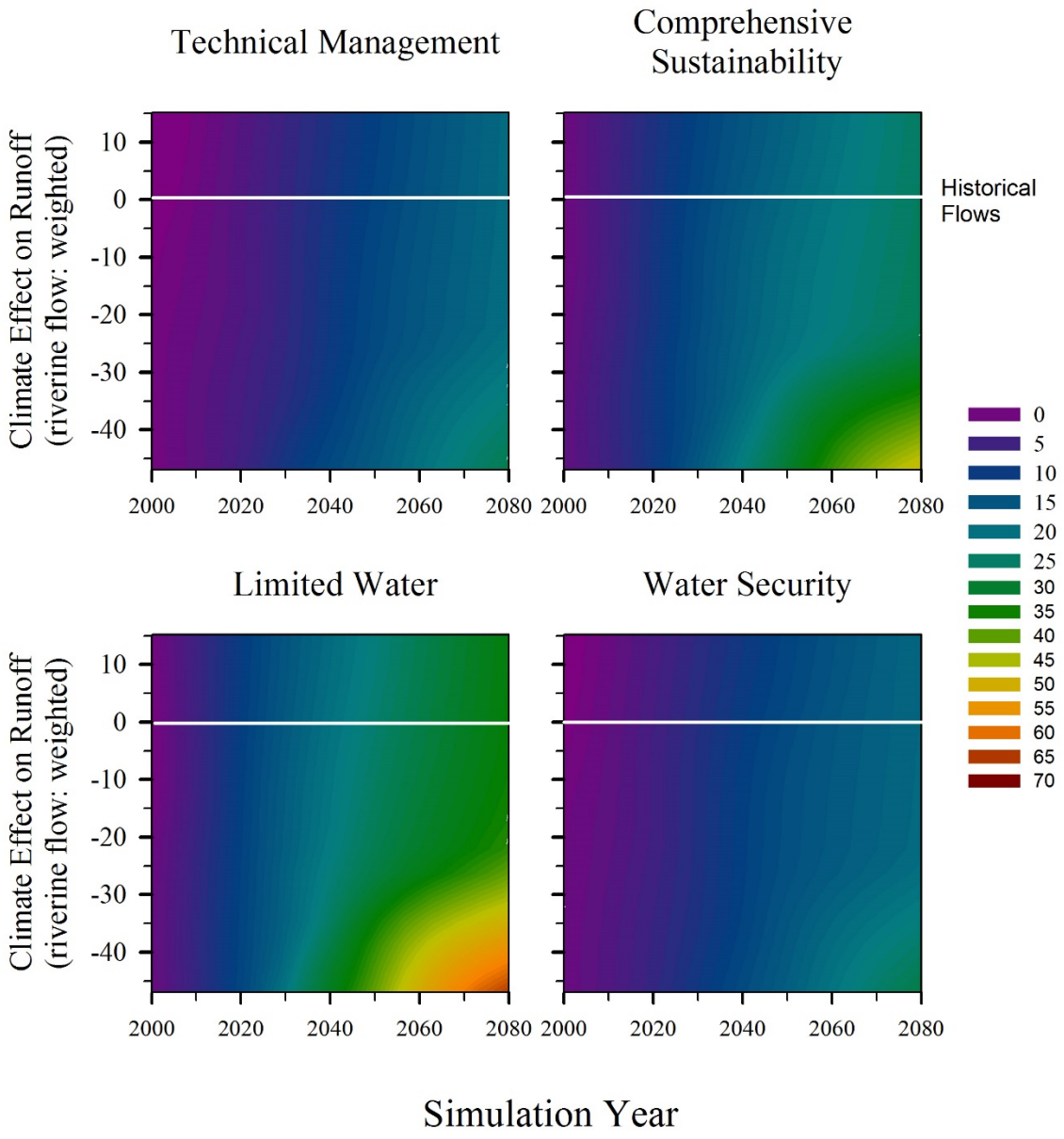
Figures

Scenario	Technical Management for Megapolitan Development	Citizen Councils Pursue Comprehensive Water Sustainability	Experts Manage Limited Water for Unlimited Growth	Collaborative Governance Prioritizes Local Water Security
Variables/Future Projections				
1. New Water	Pursued	Not pursued	Not pursued	Pursued
2. Riparian Areas	Not deliberately protected	Protected	Not deliberately protected	Not deliberately protected
3. Safe Yield	Not central to WM	Central to WM	Not central to WM	Central to WM
4. Delivery Infrastructure	Built	Not built	Not built	Not built
5. Energy for water	Mix	Renewable	Mix	Mix
6. Quality Regulations	Limited	Expansive/precautionary	Limited	Limited
7. Canals	Not developed	Tree lined	Not developed	Not developed
8. Grey Water	Not collected	Collected	Not collected	Not collected
9. Ag water	Water transferred	Water not transferred	Water transferred	Water transferred
10. Farm water use	Subsidized and unregulated	Crops and water regulated	Subsidized and unregulated	Crops and water regulated
11. Industry Use	Water-intensive industries	Consumption reduced	Water-intensive industries	Consumption reduced
12. City growth	No growth controls	Growth controls	No growth controls	Growth controls
13. Policy Instruments	No new impented	Implemented	Implemented	Implemented
14. Effluent	Drinking water	Recharge and wildlife	Industrial use	Drinking water
15. Governance	Top-down	Public-driven	Top-down	Collaborative
Selection Technique	Stakeholder survey	Sustainability appraisal	Plausibility evaluation	Governance analysis
Additive Consistency	38	53	27	28
# of Inconsistencies	0	0	1 *(1)* and *(12)*	2 *(1)* and *(4)*; *(1)* and *(15)*

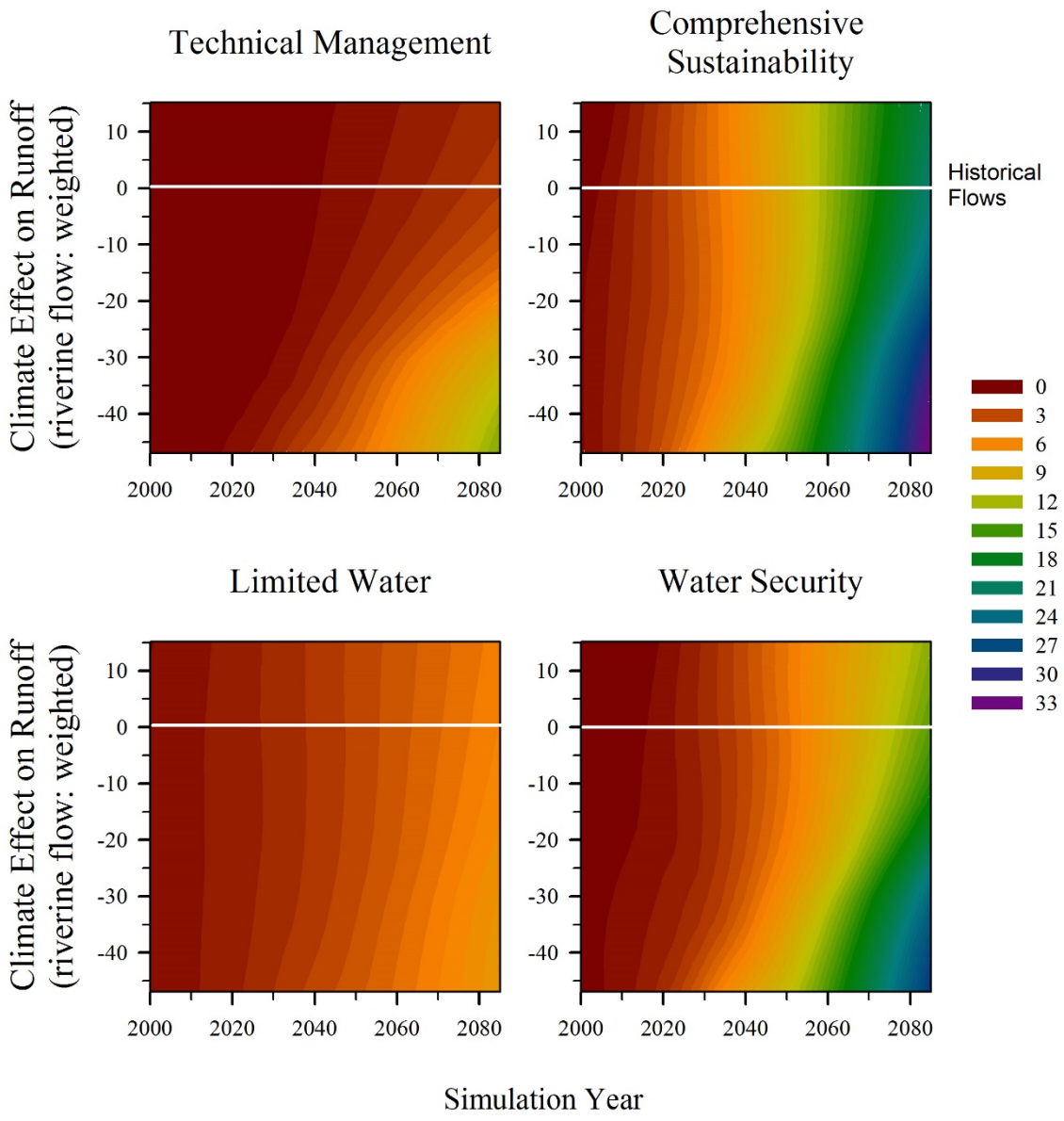




Baseline simulations for regional aquifer response and percent demand met by groundwater.



Change in the percent of demand met by groundwater from baseline simulation.



Percent change in groundwater aquifer from baseline simulations